



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## STREAM POLLUTION<sup>1</sup>

BY HENRY B. WARD

It was the author's privilege to spend last summer in studying the problems of stream pollution in New York under the auspices of the Conservation Commission of that state. In connection with the work he found not only a general problem of great interest but particular relations to the work of the various private and public water supply systems that seem of sufficient interest to justify discussing them informally here. The topic of stream pollution presents an aspect of growing importance in connection with the great conservation problems which are being emphasized not only to maintain but to improve upon the position that has been given them in connection with the activities of the war. On this occasion it is proposed to speak on those aspects of water supply work that concern our aquatic resources and their relations to the human species.

New York State has a finely organized Conservation Commission. In its various subdivisions it comes in contact with the natural resources of the state at many angles. From its files abundant evidence has been obtained in the reports of game protectors, of the engineering division, and other bureaus concerning the situation in the state and the changes with reference to stream pollution that have taken place within recent years. The author was able to examine personally the situation on some of the characteristic streams, including both such as were relatively small and also the upper Hudson itself.

There is no doubt that stream pollution has increased enormously within a brief period. From a situation in which it was of significance in very few localities it has increased to the point where it exerts an unfavorable influence upon streams in practically all sections of the state. To be sure, in the forest reserves of the Adirondacks it is even today either an unknown influence or of

<sup>1</sup> Read before the Illinois Section March 27, 1919.

relatively little significance, but generally speaking one could get evidence everywhere in the state that the condition of the waters and of the life in them was being constantly and adversely affected by the addition of trade wastes.

The author's own estimate of the situation bore out the general report. He was born at Troy; as a boy he boated and swam and fished in the waters of the upper Hudson near and above that city. After an absence of some thirty years he went over the same ground during the past year. The changes in the situation were remarkable. Places which in former years had manifested all evidences of relatively pure water, abundant aquatic life and normal biological conditions have been so highly modified by the changes of thirty years that in some places they even look like the banks of an open sewer or the stretches of a septic tank. Not only were the aquatic organisms gone that had formerly been abundant but the conditions of existence had been so radically modified that such organisms could no longer sustain themselves. It was easy to demonstrate the presence of waste materials in the stream. One found in the deposits along the shore and on the bottom, as well as in materials floating in the water, evidence so definite that no chemical examination was required to confirm the findings.

The situation was not unique at this point. It was duplicated at many other places on the Hudson. It recurred with small changes, due to varying factors in the environment, on the Susquehanna near Binghamton and on streams in western New York that empty into Lake Erie. It was possible easily to secure evidence that these conditions had grown rapidly worse within very recent years, and in the opinion of careful observers the situation was directly produced by the introduction of the manufacture of chemicals and the increase in the amount and character of chemical wastes produced in various industries. To be sure the amount of waste uncared for had multiplied abnormally under the pressure of war conditions, for during war times no attention could be paid to the reclamation of wastes or to any other factors save maximum speed in the production of the materials needed for war service. But after all possible allowance had been made for this phase of the situation, it was none the less clear that stream pollution was on the increase and was seriously modifying the biological character of aquatic environments.

In the next place attention is called to the fact that it is impossible to discuss the relation of these things to the water supply and to the work of the members of this Association without commenting specifically upon the classification usually employed with reference to wastes and upon a certain confusion which is introduced into our minds by virtue of this classification. Waste materials are usually designated as domestic wastes and industrial wastes. From the biological standpoint this distinction is fully justified and is of great importance insofar as it is related to real differences. Such differences actually exist and are the basis of the distinction in terminology. The organic wastes of city sewerage systems form a distinct class; they are modified by natural processes too well known to require discussion here and are transformed with well recognized and definitely known rapidity into materials that serve to maintain certain types of organisms in the water. When not excessive in amount they may rightly be said to have a favorable action upon the life in the stream.

Industrial wastes are radically different in character and effect. They are not easily changed by natural processes. They continue unmodified for long periods of time and by movement of the water extend their influence over long distances. Their deposit upon the surfaces of stones and of plants produces a covering that in extreme instances is unmodified by the passage of time in the ordinary sense and that so long as it exists prevents the development of living things. They are thus in the highest degree destructive to normal and desirable conditions.

It must be noted, however, that the distinction between these two types of waste cannot be maintained in practice at the present time. Our cities have not merely increased in size; they have radically modified their character. Even the smallest of them have undergone changes that are apparent on reflection. To the normal wastes of the human population have been added the sweepings and washings of a multitude of manufacturing plants, large and small, all of which turn their materials into the sewers as the easiest method to dispose of them. These waste materials include oils and other chemical wastes of a resistant character that exert upon living organisms in the stream an influence differing only in degree from that exerted by the same sort of materials discharged from great industrial plants. The accumulation of a multitude of such small additions throws a large burden upon the sewerage system and

through it upon the waters into which that system empties. The sewage of Troy is discharged into the Hudson about five miles above the point where Albany gets its drinking water. Years ago natural processes of change made over the materials discharged before even that brief distance was traversed. Today, however, the sewage of Troy is no longer to be regarded as a domestic waste. It contains large amounts of chemicals, if indeed the materials discharged from manufacturing plants and properly classified as industrial wastes do not actually exceed in amount those emanating from the population, which alone are properly classified as domestic wastes. The results on the character of the stream are conspicuous and well known to those who have examined the situation or have read the records of the work done to secure proper drinking water for the city of Albany. The situation at this point is not unique; it could be duplicated at many other places, and water works officials are more familiar than the author with the extent to which municipalities have been compelled to install treatment works in order to secure a proper water supply because of the contamination that the stream has suffered at the hands of communities and industrial plants located higher up.

This is the first of the items to which the author wishes to call attention in discussing the significance of stream pollution for the problems with which water works officials have to deal. It is impracticable and, the author thinks, also unnecessary to discuss the situation in detail from the chemical standpoint. The authorities of many municipalities have experienced difficulties in obtaining and purifying their water supply. In some cases it is one kind of waste and in other cases another with which they have to deal. These difficulties are, and will be for a long time, under detailed discussion in literature and water works officials are more familiar with them than the author could possibly be. His general contention should, however, be clear. The problem of water supply has been made more difficult to solve by virtue of the addition to the normal domestic wastes of large quantities of industrial wastes added indirectly to the stream flow through the medium of city sewerage systems.

Even superficial examination of any large stream like the Hudson River on which are located multitudes of manufacturing plants will serve to show how radically the situation in the stream has been modified in direct fashion by the addition of industrial wastes.

Such materials are poured into it in quantities from various kinds of establishments, by manufacturers of sulphite pulp, by manufacturers of chemicals, by laundries, by gas plants and by multitudes of other industrial concerns that are located along its banks. In the individual cases such a contribution of waste material would exert little or no influence upon the character of the water and the life that it normally contains, but the sum total of these numerous additions is sufficient to wipe out the normal life of the stream and for long stretches the river has been reduced to the level of a stream of polluted water. The mass of material is so great that under existing conditions the stream does not and cannot restore itself and the influence of the industrial wastes may be traced on the banks and bottom bare of living organisms but covered with a slimy and putrid deposit offensive to eye and nose alike. No one industry and no one community is responsible, but the responsibility must be assumed by all and the solution of the problem must be sought in joint and coöperative action.

Such problems concern perhaps most conspicuously the older cities and states of our country. They have not yet made their presence felt in such conspicuous fashion in the newer regions, but it is not too much to say that even in the state of Illinois there are places which give direct evidence of the existence of this problem here and the need for attacking and solving it before it has become more difficult and more extended. Public conferences held in New York State show that public officials in various cities were awake to the importance of the question. Representatives of the State Conservation Committee, of the State Board of Health, of various water companies in the state, of manufacturing industries, and of the commercial fishermen discussed from various angles the difficulties with which each had to contend because of the situation. In that state the Conservation Commission has started a movement to find and apply a remedy. It appears in that instance that the laws of the state, if effectively and impartially enforced, will eliminate much of the evil since those laws provide that industrial waste may not be discharged into any streams in quantity sufficient to interfere with the life or with the reproductive activities of the fish in those waters. In other states the laws may not be adequate and the first step in the situation may be to provide new legislation. It is, however, not too early to examine the situation with a view to determining definitely what must be done in each commonwealth

and prompt action upon the plan decided upon is demanded in the general public interest.

Attention may well be called to the other aspect of the question. There are some ways in which present practices in the field of water supply influence in entirely unexpected manner the character of the stream and its value to the state. One curious instance came to light in connection with the study of a fish epidemic. In a district where the entire watershed was set aside as a reserve and kept for the purpose of furnishing a water supply to a great city the trout in the stream began to die off and perished in large numbers. Evidently some element had been introduced into the situation that was very unfavorable to their existence and might be equally serious for the human species. The cause was not easy to find as the entire region had been kept under most careful control. The commission in charge of the area had apparently so regulated habits and practices as to eliminate all sources of contamination, but after some study the cause was found. Employees were using closed toilets in which powerful chemicals were utilized to treat the waste. These toilets had been emptied into a sink hole a short distance from the stream and with shifting conditions flood water had cut a channel from that depression into the stream itself. With the water came chemicals sufficient in amount to cause the death of the fish. Possibly this insignificant instance does no more than to illustrate the difficulty of controlling absolutely any situation, especially when one has to deal with workmen who are more or less careless and lacking in understanding of the principles which should direct the management of such an undertaking.

The effect of water treatment on the organisms that find their natural habitat in the stream is one on which but little evidence has been collected. The use of chlorine to make city water supplies safe for human consumption is general, but there are on record few if any observations concerning the effect of this treatment on the fauna and flora of the water. A single instance came to my attention in which such treatment was followed by the prompt and total extermination of the minute free living organisms at a distance of several miles at least below the point at which the treatment was undertaken. How far the influence extends, what sort of organisms are affected and to what extent, are questions that need evidently careful consideration. It is important not to lose sight of the fact that serious secondary consequences may follow the introduction of

some treatment that accomplishes the primary result sought for. It is not complete justification of such secondary destruction to maintain that the primary effect was the one desired and that incidental results may be entirely neglected. One may reasonably contend that no method is entirely satisfactory if it achieves a gain at one point by virtue of a loss at another unless the latter is shown to be inseparable from the former no matter what methods of procedure may be followed.

It has been maintained that it would be of advantage to the human species if all of the organisms in our streams could be eliminated since thereby the chance of human infection would be eliminated also. Undoubtedly those who hold such views have in mind really the elimination of such organisms as exert an unfavorable influence upon the water or upon the human species. It seems to the author, however, to be unfortunate that this point of view overlooks entirely other relations of our water bodies. It would certainly be a great loss to the human race from many points of view if all types of life in our streams were totally wiped out. This experiment has actually been tried on a grand scale in western Pennsylvania where the use of streams for washing in the coal mining industry has resulted in imparting to the waters so much sulphur and sulphuric acid that all life in the stream has been entirely wiped out and one may travel for miles without being able to find any of the living organisms which ordinarily frequent such water bodies. In that individual case it is evident that the water has not been improved for human consumption since it has been found impossible to use it in city water supplies.

It is true, to be sure, that water courses follow natural channels, and that whatever liquid waste is produced must sooner or later find its way into those channels and follow them down hill. We cannot hope to make water run up hill successfully under any other than very limited conditions, but this is by no means a justification for turning loose all sorts of liquid wastes to find their way into the streams, whatever be the effect upon those streams. In the author's opinion, the principle at issue can be well illustrated by comparing the waterways to the roadways of the country. Very likely there are some persons in the audience who can recall the period at which any convenient roadside was regarded as an entirely proper place to deposit refuse and when piles of waste material in different stages of disintegration might be found in many places,



even in our cities. In fact, it was long considered good form, in certain social circles and certain districts at least, to pitch all sorts of waste matter over the fence into a vacant lot or to pile it in the back alley if not in the front street. The practice of garbage disposal after this fashion was all too general at one time among a large part of the population. Today no one would think of justifying such a procedure, and whether it be in one portion of the city or another, every well regulated municipality would visit a heavy penalty upon the citizen that indulged in such habits of disposing of his waste. At the present day our streams stand exactly in the place where our streets were fifty years ago. The public regards them as a convenient and proper place for the dumping of refuse. Waste thrown into a stream is ordinarily carried on well below the point where it is deposited and usually so thoroughly removed as to leave no evidence at the point where it started. Furthermore, it carries with it no marks which enable the finder to determine the place of its origin. It is well known that both state and national governments have had to deal with various communities and regions because the practice of dumping refuse in streams had been carried to the point where it was seriously interfering with the navigation of the stream, so that in general local or state regulations provide today that refuse may not be dumped from city docks into navigable streams. However, the practice has not been abandoned and some times assumes serious proportions, as may be witnessed in many places in connection especially with the smaller streams of the region in which this meeting is held. It is essential to develop public sentiment against this abuse and this can be done only by educating the people to appreciate the need for keeping the streams as clean and free from waste and refuse of all sorts as the streets of our well kept cities.

The attitude of the individual citizen is but a copy on a small scale of the attitude of the large industry. The solution of the problems of stream pollution will never be found until men and corporations are led to see that their own legitimate rights do not include the privilege of trespassing upon the rights of others. It may be expensive for the citizen to provide that his garbage is disposed of in proper fashion, but the community decrees that he shall assume that expense and penalizes him if he fails to heed the regulations controlling the matter. In the same way it may be costly for business to care for waste chemical substances that are

produced in the course of its manufacturing procedure, but this expense must equally be regarded as a part of the natural and inevitable cost of the business. It is not just to saddle it in whole or in part on the community to its disadvantage or to pass it on to the disadvantage of those living below on the banks of the stream or seeking to use the water as a basis for individual or community water supply. Provisions must be made to compel each individual and each interest to care for its own responsibilities and to pass on the water of the stream to those lower down in as good condition as it was received from the region higher up.

One factor which has served to draw attention to the question has grown out of the manufacturing industry itself. The plant located downstream has ascertained that the water is not desirable for its purposes because of the addition of wastes from some manufacturing plant higher up on the water course, and the man lower down has sought to establish his right to secure as good a supply of water as that which came to his neighbor higher up. Individual water companies and communities, both small and large, have noted the deterioration in the quality of their water by virtue of the changes wrought in the streams through the addition of manufacturing wastes in the enormous quantities in which they are contributed by some of our great present day industrial plants. The insignificant evil of yesterday has grown so large it is unbearable today. The only real solution of the difficulty lies in the maintenance of natural conditions. When all classes of people are interested in our streams from different points of view, when they coöperate in introducing, passing and enforcing proper regulations to grant equal rights and privileges to all and on the other hand to demand equal consideration from all, then it will be possible to remedy the present situation. However far in the future this ultimate solution of the question may lie, it is imperative that some steps be taken now throughout our country to stop the rapidly increasing pollution, to limit the destruction of the natural aquatic resources and to preserve from further deterioration the present water supply. To this must be added as rapidly as possible another but related movement for the total elimination of those evils which have grown up in the past. Conditions must not be allowed to grow worse at any point and must be improved as rapidly as possible.